FEATURED ORAL PRESENTATION

# 831FO Featured Oral Session...Stress Echocardiography: Innovations and Progress

Monday, March 18, 2002, 4:00 p.m.-5:30 p.m.
Georgia World Congress Center, Room 264W

4:15 p.m.

## 831FO-2 Phenylephrine Stress Echocardiography: A New Pharmacologic Test to Evaluate Mitral Regurgitation

Patrick J. Nash, William J. Stewart, *Cleveland Clinic Foundation, Cleveland, Ohio.*

**Background:** Mitral regurgitation (MR) is a dynamic condition, but its severity varies with alterations in LV loading conditions. This is a problem especially when the MR severity is less than suspected clinically.
**Methods:** We developed a Phenylephrine Stress Echo (PSE) protocol using this selective α-1 adrenoreceptor agonist, given carefully through an open peripheral intravenous line in 100 mcg aliquots, to increase mean arterial pressure by >20 mm Hg, while performing quantitative Doppler in 33 adult patients. Using TEE in 25 and TTE in 8 pts, and monitoring blood pressure after each dose of phenylephrine, we used spatial mapping with color Doppler at Nyquist 50-60 cm/sec, regurgitant orifice area (ROA) using flow convergence, MR stroke volume, and an overall grading on a 1-4+ scale representing a weighted average of all methods.
**Results:** Echo parameters of MR increased from phenylephrine, see table. The total dose averaged 380 mcg (range: 50-1500). No adverse effects were noted. In 10 pts ROA increased by > 0.2 cm2; in some of these, the PSE-documented propensity to develop severe MR explained the previous clinical events and impressions. In 23 pts, ROA increased by < 0.2 cm2; in some of whom, failure to increase MR to surgical levels reinforced the safety of delaying valve repair.
**Conclusions:** PSE can document dynamic changes in the severity of MR with increasing afterload, which can assist with clinical decision-making, particularly when MR is less than was clinically suspected.

| | Pre-Phenylephrine | Post-Phenylephrine |
|---|---|---|
| **MR** (graded 1-4+) | 1.9 ± 0.6 | 2.6 ± 0.7 |
| **Regurgitant Orifice Area (ROA)** (cm2) | 0.18 ± 0.09 | 0.37 ± 0.18 |
| **Mitral Regurgitant Stroke Vol** (ml) | 30 ± 18 | 84 ± 53 |
| **Systolic Blood Pressure** (mmHg) | 118 ± 20 | 153 ± 30 |
| **Diastolic Blood Pressure** (mmHg) | 71 ± 15 | 92 ± 23 |
| **Mean Arterial Blood Pressure** (mmHg) | 87 ±16 | 112 ± 22 |

4:30 p.m.

## 831FO-3 QTc Interval Shortening During Dipyridamole Stress Test Predicts Severe Coronary Artery Disease in Patients With Left Bundle-Branch Block

Mauro Bertella, Filippo Scalise, Patrizia Valentini, Giuseppe Eriano, Romano Valentini, Michele Nanna, *Montefiore Med Ctr / Albert Einstein Coll of Med, Bronx, New York, Vimercate Hospital, Vimercate, Italy.*

Background: Stress Echo, estimating transient changes of regional kinesis and systolic thickening, is an established modality with high diagnostic accuracy in detecting LBBB-associated coronary artery disease (CAD). The shortening of QTc interval (QT corrected for heart rate using Bazett's formula) (QTcS) is an ECG marker of transmural ischemia, validated in experimental and clinical studies. The aim of this study was to assess the significance of induced QTcS, in patients (pts) with left bundle-branch block (LBBB), during Dipyridamole Stress Test (DST). Methods: 15 consecutive pts (8 men, age 65±4 years), with complete LBBB, but without any echocardiographic evidence of scarred segments in the left ventricle, underwent DST and coronary angiography for chest pain work up. Dipyridamole was infused up to 0.84 mg/kg over 10 min. QTc intervals were measured lead by lead, in blinded manner, at rest and peak stress; in all leads showing ST-T changes the fractional percentage difference in QTc intervals (Delta QTc) from baseline was calculated. We considered significant a Delta QTc cut-off value of 65 % reduction of luminal diameter. Results: Prevalence of CAD was 80 % (normal coronary arteries were found in 3 pts). On the basis of QTc behavior during DST , 2 groups (Gr) were identified: Gr I, "shorteners ", 10 pts (Delta QTc= -16± 5%) and Gr II, "non shorteners", 5 pts (Delta QTc= +7 ±13%), p<0.0001. Significant differences between the 2 groups were found regarding the prevalence of stress-induced dyskinesia: Gr I= 9 of10 pts (90%) vs Gr II = 1of 5 pts (20%), p < 0.05) and the severity of %narrowing in the vessel supplying the stress-induced dyssynergic area (Gr I= 94 ± 4 % vs Gr II= 72.5 ± 2.5%, p <0.001). Conclusions: In pts with LBBB, QTcS during DST, is associated with stress induced dyskinesia and more severe stenotic lesions in the ischemic area at risk. This simple ECG parameter could complement other markers in identifying severe CAD in LBBB pts.

4:45 p.m.

## 831FO-4 Comparative Prognostic Value of Dobutamine Versus Dipyridamole Stress Echocardiography for Perioperative Cardiovascular Risk Assessment in Patients Undergoing Major Vascular Surgery

Miklos D. Kertai, Sicari Rosa, Gilbert J. L'Italien, Jos RTC Roelandt, Don Poldermans, *Erasmus Medical Center Rotterdam, Rotterdam, The Netherlands, CNR Institute of Clinical Physiology, Pisa, Italy.*

**BACKGROUND:** The proper management of patients undergoing major vascular surgery requires an accurate preoperative assessment of their underlying cardiac risk. Clinical risk factor information can be used in conjunction with appropriate diagnostic testing to identify high risk patients. We explored the comparative added prognostic value of Dipyridamole Stress Echocardiography (DiSE) with Dobutamine Stress Echocardiography (DSE) in a cohort of vascular patients.
**METHODS:** The study group comprised 1487 consecutive patients who underwent either DiSE (n=394) or DSE (n=1093) testing before major vascular surgery. Logistic regression was used to identify predictors of outcome (cardiac death/non fatal MI with 30 days of surgery.) Clinical risk factors included age≥70yrs, gender, history of myocardial infarction (HxMI), angina pectoris (Hx AP) and diabetes mellitus (DM). Positive DSE or DiSE results were defined as new or worsening wall motion abnormalities (NWMA).
**RESULTS:** The average perioperative cardiac event rate was 3.9% in the DSE group compared to 3.5% in the DiSE group. DiSE was positive for ischemia in 16.8% of patients and DSE in 19.8%. Multivariate regression analysis showed that NWMA had a better predictive value in DiSE as compared to DSE (Table).
**CONCLUSION:** In this study, DiSE had greater prognostic value than DSE for predicting perioperative cardiac events in vascular patients.

| Variables | DSE Odds Ratios (95% CI) | DiSE Odds Ratios (95% CI) |
|---|---|---|
| Age≥70y | 1.8 (0.9-3.5) | 2.1 (0.6-7.5) |
| Male | 1.3 (0.6-3.1) | 0.3 (0.03-2.9) |
| Hx Angina | 0.8 (0.4-1.6) | 0.6 (0.1-3.3) |
| Hx MI | 2.1 (1.03-4.03) | 0.9 (0.3-3.3) |
| Hx Diabetes | 1.6 (0.7-3.4) | 0.7 (0.1-5.2) |
| NWMA | 9.3 (4.6-18.5) | 105.0 (12.00-932.0) |

5:00 p.m.

## 831FO-5 Vasospasm in Acute Coronary Syndrome: Does Ergonovine Stress Echocardiogram Have a Role?

Moo H. Kim, Tae H. Park, Doo K. Yang, Il W. Oh, Kwang S. Cha, Young D. Kim, Jong S. Kim, *Dong-A Medical College, Pusan, South Korea.*

**Background**: Ergonovine stress echocardiography (ESE) has been reported as a useful tool for the diagnosis of vasospastic angina. However, the role of ESE for depicting underlied vasospasm in acute coronary syndrome (ACS) has not been evaluated well. Therefore, we sought to investigate the role of vasospasm in patients with ACS.
**Methods**: From June 1999 to August 2001, the study included 50 ACS patients (mean age 54 ± 9, 41 male) with normal coronary angiogram who initially presented either 1) continuing chest pain longer than 20 minutes or 2) cardiac enzyme elevation (cardiac troponin above the cutoff value or CK-MB above 2 times of upper limit) associated with chest pain. After discontinuation of antianginal medication for more than 3 days, ESE were performed in all 50 patients by 6 staged intravenous injection of ergonovine (50 μg in each stage, total dose ≤ 350 μg ). Regional wall motion change (RWMC) was assessed continuously in multiple echocardiographic views.
**Results**: Clinical diagnosis of the study patients included 26 unstable angina, 15 non-ST elevation MI and 9 ST elevation MI patients. Smoking was present in 30 (60%), hypertension in 15 (30%), diabetus mellitus in 11 (22%) and hypercholesterolemia in 5 (17%) patients. Among the study patients, 19 patients (38%) showed RWMC following the ergonovine injections. Involved arteries were 14 in left anterior descending artery (LAD), 4 in right coronary artery (RCA) and one in multi-vessel territories ( LAD + RCA). Side effects included headache in 2, nausea in 3, dizziness in 3 and hypotension in 1 patient. Cardiac resuscitation was needed without sequelae in one patient who developed multivessel spasm during the examination.
**Conclusion**: Vasospasm was involved in one third of the patients whose initial clinical presentation of unstable angina or AMI, with normal coronary angiogram. ESE can be a valuable diagnostic tool to assess the role of coronary spasm in these patients.

5:15 p.m.

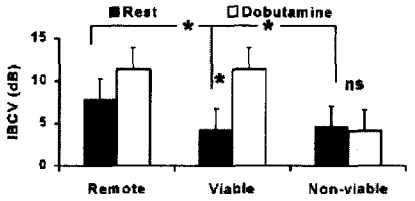
## 831FO-6 Postinfarction Myocardial Viability Diagnosis With Integrated Backscatter Cyclic Variations During Dobutamine Infusion

Paolo Colonna, Roberta Montisci, Christian Cadeddu, Luigi Meloni, Sabino Iliceto, *Cardiovascular and Neurological Dept. , University of Cagliari, Cagliari, Italy.*

**Background**: The integrated backscatter cyclic variations (IBCV) are a quantitative index related to myocardial contractility, which are reduced in post-infarction dyskinetic myocardial segments. In the acute phase of myocardial infarction the diagnosis of myocardial viability is difficult and operator dependent. We hypothesized that the analysis of second harmonic IBCV can be used for a less operator dependent diagnosis of myocardial viability.
**Methods**: We studied 12 patients within 4 days of acute myocardial infarction with transthoracic low dose echo dobutamine test for viability. In parasternal long axis view we

analysed IBCV, at rest and during 10 mcg/Kg/min infusion (dobutamine), in 24 remote, and 24 dyskinetic myocardial segments. The dyskinetic segments were considered viable or non-viable depending on myocardial functional recovery at 30 days echocardiographic follow up.

**Results**: In the remote segments, IBCV at rest were significantly greater than in dyskinetic viable and non-viable segments (respectively 7.8±3.1 dB vs 4.3±1.4 dB, vs 4.7±0.8 dB; *p<0.001).




During dobutamine, IBCV increased significantly in remote (11.4±4.5 dB, * p<0.001 vs rest) and in viable segments (11.4±2.6 dB, p<0.001 vs rest), but did not in non-viable segments (4.1±1.5 dB p=ns vs rest).

**Conclusion**: After acute myocardial infarction, the second harmonic IBCV analysis during dobutamine echocardiography is a new promising tool to detect myocardial viability in dyskinetic segments.

ORAL CONTRIBUTIONS

# 835 Echo-Doppler Assessment of Cardiovascular Hemodynamics

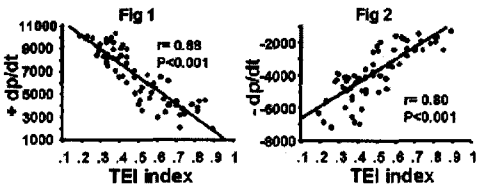
Monday, March 18, 2002, 4:00 p.m.-5:30 p.m.
Georgia World Congress Center, Room 254W

4:00 p.m.

## 835-1 Validation of TEI Index in the Estimation of Cardiac Function: An Experimental Study

Shiro Yoshifuku, Sadatoshi Biro, Yoshiyuki Ikeda, Yasuyuki Kamogawa, Yutaka Otsuji, Shinichi Minagoe, Chuwa Tei, *Kagoshima University, Kagoshima, Japan.*

**Background**: Although estimation of cardiac function is important in heart failure, noninvasive and reliable methods remain to be invented. We have reported that Doppler TEI index, defined as sum of isovolumetric contraction and relaxation time divided by ejection time, is clinically useful to assess cardiac function. The aim of this study is to validate the TEI index using TO-2 cardiomyopathic hamster, an animal model of congestive heart failure (CHF). **Methods**: Twelve control and 55 male TO-2 hamsers, which develop CHF around 30 weeks and die within a year, were used. Left ventricular (LV) + and -dP/dt were measured by a Millar catheter. LV diastolic and systolic dimensions (LVDd, LVDs), fractional shortening (%FS) and LV TEI index were measured by a 10MHz transducer. **Results**: LV + and -dP/dt of TO-2 gradually decreased with age. There were significant correlations between +dP/dt and TEI index (r=0.88, P<0.001, Fig 1), %FS (r=0.81, P<0.001), LVDd (r=0.80, P<0.001) and LVDs (r=0.73, P<0.001). Multiple regression analysis revealed that TEI index was the best correlation (P<0.001), but not %FS (n.s.), LVDd (n.s.) or LVDs (n.s.). For -dP/dt, TEI index (r=0.80, P<0.001, Fig 2), %FS (r=0.77, P<0.001), LVDd (r=0.74, P<0.001) and LVDs (r=0.78, P<0.001) were significant determinants, but only TEI index was significant in multiple regression analysis (P<0.001). **Conclusion:** These results suggest that TEI index is a valid parameter that can evaluate combined systolic and diastolic function.




4:15 p.m.

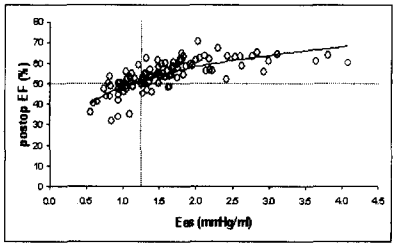
## 835-2 Evaluation of Left Ventricular Contractile Function Using Noninvasively Derived End-Systolic Elastance in Mitral Regurgitation: Experimental Validation and Clinical Study

Yong Jin Kim, Michael Jones, Takahiro Shiota, Jian Xin Qin, Neil L. Greenberg, Zoran B. Popovic, Jun Kwan, Marta Sitges, Fabrice Bauer, Hua Yang, Lisa A. Cardon, Vandana Sachdev, Brian P. Griffin, Delos M. Cosgrove, III, James D. Thomas, *The Cleveland Clinic Foundation, Cleveland, Ohio, National Heart, Lung and Blood Institute of Health, Bethesda, Maryland.*

**Aim: 1)** To validate the noninvasive estimation of left ventricular (LV) end-systolic elastance ($E_{es}$) in an animal model of chronic mitral regurgitation (MR) and **2)** to predict postoperative LV function with the noninvasively derived $E_{es}$ in patients with MR.

**Methods: 1)** Eight sheep with MR were studied with 4 different loading conditions. $E_{es}$ was measured as the slope of the end-systolic pressure-volume relationship during IVC occlusion with a conductance catheter. Noninvasive $E_{es}$ was calculated by a bilinearly approximated time-varying elastance curve. **2)** 110 patients (65 ± 25 years, 75 men) with chronic MR who underwent mitral valve repair were studied. Echocardiographic studies were performed before surgery and repeated at 1 week after surgery.

**Results: 1)** In a total of 24 stages, regurgitant fraction and ejection fraction (EF) ranged from 6 to 63 % (mean: 33 ± 13) and 44 to 74 % (mean: 58 ± 8), respectively. The noninvasively determined $E_{es}$ showed good correlation and agreement with invasively determined $E_{es}$ (y = 0.8 x + 0.6, r = 0.8, p < 0.01, $\Delta E_{es}$ = 0.1 ± 0.6 mmHg/ml). **2)** Preoperative $E_{es}$ (r = 0.77, p < 0.01) and end-systolic volume (r = 0.73, p < 0.01) correlated well with postoperative EF. Preoperative $E_{es}$ < 1.25 mmHg/ml was most predictive for identifying patients with LV contractile dysfunction (n = 28) after surgery (sensitivity: 84 %, specificity: 81%).




**Conclusions:** Noninvasive estimation of $E_{es}$ is useful for identifying early, occult LV contractile dysfunction before surgery in patients with chronic MR.

4:30 p.m.

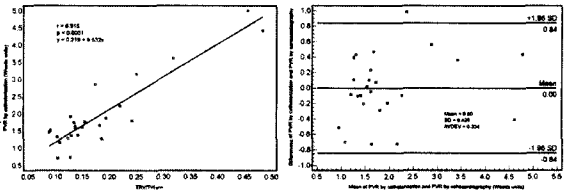
## 835-3 Is Noninvasive Evaluation of Pulmonary Vascular Resistance Possible?

Amr E. Abbas, F. David Fortuin, Nelson B. Schiller, Christopher P. Appleton, Carlos A. Moreno, Steven J. Lester, *University of California, San Francisco, California, Mayo Clinic, Scottsdale, Arizona.*

***Background:*** Pulmonary Vascular Resistance (PVR) is an important hemodynamic variable used in the management of patients with cardiovascular and/or pulmonary disease. Currently right heart catheterization, with its associated risks, is required to determine PVR using the ratio of the transpulmonary pressure gradient to the transpulmonary flow. We hypothesized that the ratio of peak regurgitant velocity across the tricuspid valve (TRV) to the right ventricular outflow tract time velocity integral ($TVI_{RVOT}$) obtained by Doppler echocardiography could act as a surrogate to PVR.

***Methods:*** TRV and the $TVI_{RVOT}$ were measured by Doppler echocardiography in 25 patients. The ratio TRV/ $TVI_{RVOT}$ was then correlated with PVR obtained by catheterization using regression analysis. An equation was modeled to calculate PVR in Woods units using echocardiography. The results were compared to invasive PVR measurements using Bland-Altman analysis.

***Results:*** The ratio TRV/ $TVI_{RVOT}$ calculated by Doppler echocardiography correlated well (r = 0.915, p < 0.0001) with PVR data obtained invasively as shown in the regression graph below. The Bland-Altman analysis between the PVR obtained invasively and by echocardiography using the modeled equation (PVR = TRV/$TVI_{RVOT}$ * 9.5 + 0.22) showed good limits of agreement (mean = 0.0, SD = 0.429).



***Conclusion:*** Doppler echocardiography can provide a reliable, non-invasive method to determine pulmonary vascular resistance.

4:45 p.m.

## 835-4 Peak Early Diastolic Velocity by Tissue Doppler Imaging Is a Better Predictor of Mortality Than Standard Doppler-Echo Measurements

Mei Wang, Gabriel Yip, Yan Zhang, Pearl Ho, John E. Sanderson, *The Chinese University of Hong Kong, Hong Kong, Hong Kong.*

Background: Tissue Doppler Imaging (TDI) of the mitral annulus provides a rapid assessment of ventricular long axis function. However, it is not known to what extent the TDI velocities in systole and diastole relate to prognosis and if they predict mortality better than the standard Doppler-Echo measurements.

Methods: 518 subjects aged 19-90 (mean 57.5), 243 females with a wide range of cardiac diseases had standard 2D-echo studies including mitral propagation velocity (Vp) and with TDI of mitral annulus in 4 positions (septal, lateral, ant-basal, inf) to give peak systolic (Sm) and peak early diastolic (Em) and late diastolic velocity (Am). Mortality at 2 years was correlated with TDI parameters by Cox proportional hazard and Kaplen-Meier survival analyses.

Results: Sm, Em and Am were all significantly lower in the non-survivors (all p0.05) between alive and dead. Mitral DT was slightly lower in the non-survivors (p=0.024). In the Cox model the best predictors were Em, Sm, LVEF, LV mass and LADs. Those with Em<3cms/s had a very poor prognosis (Fig).